SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

DOCTORATES CONFERRED BY AMERICAN UNIVERSITIES.

THE degree of doctor of philosophy has this year been conferred on 266 candidates by 27 institutions. This exceeds by 10 the number conferred in 1901, and is doubtless the largest number ever conferred by American universities. The increase from year to year is, however, uncertain and small, the numbers for the six years being 234, 222, 239, 253, 216 and 266. It seems that the number of graduate students has increased more rapidly than the doctorates, which may possibly be due to somewhat more strict requirements. Still it is rather disappointing that the number of men with a proper training for research and advanced teaching increases so slowly. It should also be remembered that the number studying in Germany tends to decrease.

The statistics here given do not agree with those published subsequently by the U. S. Commissioner of Education, and as the latter figures are widely quoted, it may be well to call attention to the fact that they are valueless. The report of the commissioner records 343 doctorates conferred in 1901, but the table shows that the largest number of degrees conferred on examination was by Taylor University at Upland, Ind., which gave the doctorate of philosophy to no less than 45 candidates. One may well wish to learn something in

regard to a university with such a remarkable record, and the information is given a few pages farther on in the report Taylor 'University' has no productive funds; its income from tuition and other fees was $4,000 and from other sources $500! Unless they are to do more harm than good, the commissioner of education must in this and other cases put his figures in a form that is not misleading.

The following table gives details in regard to the conferring of the degree during the past six years:

DOCTORATES CONFERRED.

	1898.	1899.	1900.	1901.	1902.	1903.	Total
Yale	34	30	26	39	29	36	194
Chicago	36	24	37	36	27	32	192
Harvard	26	24	36	29	31	28	174
Johns Hopkins	33	38	33	30	17	23	174
Columbia	22	33	21	25	32	39	172
Pennsylvania	24	20	15	25	14	29	127
Cornell	19	7	19	21	23	20	109
Michigan	7	4	5	3	10	10	39
Clark	12	5	9	7	1	4	38
New York	5	9	7	6	4	4	35
Wisconsin	5	7	5	5	6	2	30
Virginia	0	2	2	8	6	3	21
Brown	1	3	3	2	2	5	16
Columbian	1	0	5	3	2	4	15
Minnesota	1	2	3	2	3	3	14
California	1	3	2	2	1	3	12
Bryn Mawr	3	3	1	2	2	0	11
Princeton	0	3	3	3	1	1	11
Stanford	2	0	2	2	2	1	9
Nebraska	2	1	1	1	0	0	5
Boston	0	0	0	0	0	4	4
Vanderbilt	0	0	3	1	0	—	4
Washington	0	2	0	1	0	1	4
Georgetown	0	0	0	0	0	3	3
Kansas	0	1	0	0	0	2	3
Lafayette	0	0	0	0	0	3	3
North Carolina	0	0	0	0	2	1	3
Iowa	0	0	0	0	0	2	2
Lehigh	0	0	0	0	0	2	2
Syracuse	0	1	0	0	1	0	2
Cincinnati	0	0	0	0	0	1	1
Colorado	0	1	0	0	0	0	1
Tulane	0	0	1	0	0	0	1
Missouri	0	1	0	0	0	0	1
	234	224	239	253	216	266	1432

It will be noticed that five universities are distinctly in advance, and that a large majority of the degrees—four fifths—are conferred by seven universities. There has been no considerable change in the position of the universities during the years covered by the records, though there is apparently an increase at Columbia and Michigan and a decrease at Johns Hopkins and Clark.

The degree of doctor of science was conferred this year once by Harvard and once by Michigan, and is included with doctorates of philosophy. This degree is not needed as a substitute for the Ph.D. It does not mean that the student has done a different kind of university or even college work, but that he perhaps did not study Latin at school.* Harvard established an M.S. degree four or five years since and then abandoned it. Doubtless the D.Sc. will not survive long.

DOCTORATES CONFERRED IN THE SCIENCES.

	1898.	1899.	1900.	1901.	1902.	1903.	Total
Chicago	12	13	19	16	15	21	96
Johns Hopkins	19	17	20	19	9	10	94
Columbia	10	23	12	13	14	18	90
Harvard	11	7	15	15	14	15	77
Yale	11	15	10	18	10	13	77
Cornell	11	2	11	13	16	13	66
Pennsylvania	8	8	6	12	5	14	53
Clark	12	5	9	7	1	4	38
Wisconsin	2	4	1	3	4	0	14
Michigan	0	3	1	0	5	4	13
California	1	3	1	2	1	3	11
Columbian	1	0	3	1	1	4	10
Virginia	0	2	0	4	1	2	9
Brown	1	0	0	1	2	4	8
Bryn Mawr	1	2	1	2	1	0	7
Stanford	2	0	0	1	2	1	6
Minnesota	0	1	1	0	2	1	5
Nebraska	2	1	1	1	0	0	5
Princeton	0	3	1	0	0	1	5
Washington	0	2	0	1	0	1	4
Kansas	0	1	0	0	0	2	3
New York	1	1	0	1	0	0	3
North Carolina	0	0	0	0	2	1	3
Lehigh	0	0	0	0	0	2	2
Vanderbilt	0	0	1	1	0		2
Colorado	0	1	0	0	0	0	1
Iowa	0	0	0	0	0	1	1
Lafayette	0	0	0	0	0	1	1
Missouri	0	1	0	0	0	0	1
Syracuse	0	0	0	0	1	0	1
	105	115	113	131	106	136	706

In the second table the degrees awarded in the natural and exact sciences are given

*It may be suggested to 'Carolum Guilielmum Eliot præsidem magnificum' that there is a slight lack of courtesy in calling attention to the fact that a man probably does not know Latin, and then printing his name 'Georgius' on the commencement program.

separately. It will be noticed that the numbers are nearly equally divided between what, for lack of better terms, we must call the sciences and the humanities. The order of the universities is not the same here as for the total number of degrees conferred, showing that the sciences are relatively more favored at some institutions than at others.

DOCTORATES CONFERRED IN THE SCIENCES.

	1898.	1899.	1900.	1901.	1902.	1903.	Total.
Chemistry	27	32	26	28	26	33	172
Physics	11	7	15	23	12	14	82
Psychology	18	15	9	13	8	16	79
Zoology	12	11	11	15	16	12	77
Mathematics	11	13	11	18	8	7	68
Botany	11	11	12	8	11	9	62
Geology	6	5	5	10	6	10	42
Physiology	4	1	4	1	8	8	26
Astronomy	3	2	4	5	2	4	20
Education	0	5	8	2	1	2	18
Sociology	0	5	3	3	4	2	17
Paleontology	0	4	2	1	0	2	9
Bacteriology	0	1	1	1	1	3	7
Anthropology	2	0	2	1	0	1	6
Anatomy	0	0	0	1	0	4	5
Agriculture	0	0	0	0	2	2	4
Engineering	0	0	0	1	0	3	4
Mineralogy	0	2	0	0	1	1	4
Pathology	0	0	0	0	0	3	3
Meteorology	0	1	0	0	0	0	1
	105	115	113	131	106	136	706

In the third table details are given for the separate sciences. More degrees are always conferred in chemistry than in any other science. This year there were 33 degrees in chemistry, 16 in psychology, 14 in physics, 12 in zoology and 10 in geology. We are pleased to note an increase in the number of degrees in pathology, bacteriology, physiology and anatomy. The universities conferring three or more degrees in a science are: Columbia—chemistry 4, geology 4, psychology 4, zoology 3; Pennsylvania—chemistry 5, physics 3; Chicago—chemistry 4, botany 4; Harvard—chemistry 4, psychology 4; Johns Hopkins—physics 4, chemistry 3; Clark—psychology 3; Yale—chemistry 3.

The names of those on whom the degrees were conferred and the subjects of their theses are as follows:

UNIVERSITY OF CHICAGO.

Solomon Farley Acree: 'Condensations in the Aromatic Series.'

Theodore Christian Frye: 'Fertilization and Attendant Phenomena in *Asclepias* and *Acerates*.'

Eugene Paul Schoch: 'The Red and the Yellow Mercuric Oxides and the Mercuric Oxychlorides.'

Edward Emery Slosson: 'On Acylhalogenamine Derivatives and the Beckmann Rearrangement.'

Charles Hugh Neilson: 'The Hydrolysis and Synthesis of Fats by Platinum Black.'

Ralph Waldo Webster: 'On Osmotic and Ionic Effects in the Absorption of Liquids by Animal Tissues.'

William Albert Hamilton: 'On the Convergency of the Series in the Determination of the Elements of Parabolic Orbits and the Errors Introduced in the Elements by Imperfections of the Observations.'

Mary Hefferan: 'A Comparative Study of a Group of Chromogenic Bacteria.'

Charles Ingbert: 'The Enumeration of the Modulated Nerve-Fibers in the Dorsal Spinal Nerve-Roots of Man.'

William J. Moenkhaus: 'The Development of the Hybrids Between *Fundulus heterocletus* and *Menithia notata* with Especial Reference to the Behavior of the Maternal and Paternal Chromatin.'

Henry Taber Upson: 'Molecular Rearrangements in the Orthoamino Phenol Derivatives.'

John Broadus Watson: 'The Psychic Development of the White Rat Correlated With the Growth of its Nervous System.'

Harry Gideon Wells: 'Experimental Fat Necrosis.'

William Clinton Alden: 'The Evolution of the Darien Lobe of the Lake Michigan Glacier.'

Bennett Mills Allen: 'The Development of the Ovary and the Testis in the Mammals.'

Wallace Walter Atwood: 'The Glaciation of the Wasatch Mountains.'

John Frederick Garber: 'The Life History of *Ricciocarpus natans*.'

Kate Gordon: 'On the Psychology of Meaning.'

George Mellinger Holferty: 'Contribution to the Life History of *Potamogeton*.'

Oswald Veblen: 'A System of Axioms for Geometry.'

Harry Nichols Whitford: 'The Ecological Relations of the Coniferous Forests of the Flathead Valley, Montana.'

COLUMBIA UNIVERSITY.

Joseph Hershey Bair: 'The Practice-curve; a Study in the Formation of Habits.'

Rudolph Michael Binder: 'Feeling as the Principle of Individuation and Socialization.'

Myrick Nathaniel Bolles: 'The Concentration of Gold and Silver in Iron Bottoms reduced from Highly Ferruginous Copper Mattes.'

William Campbell: 'The Microscopical Examination of the Alloys of Copper and Tin.'

Charles William Dickson: 'The Ore Deposits of Sudbury, Ontario.'

George Irving Finlay: 'The Nephetite-syenite and Associated Dikes in the San Carlos Mountains, Tamaulipas, Mexico.'

Philip Bovier Hawk: 'Influence of Hemorrhage upon Metabolism.'

Ernest Norton Henderson: 'A Study of Memory for Connected Trains of Thought.'

Douglas Wilson Johnson: 'The Geology of the Cerrillos Hills, New Mexico.'

Ernest Beckwith Kent: 'Constructive Work in Elementary Education.'

Joseph Edward Kirkwood: 'The Comparative Embryology of the Cucurbitaceæ.'

Richard Swann Lull: 'Footprints of the Jura-Trias of North America, with a Preliminary Revision of the Eastern, Vertebrate Fauna of the Period.'

James Franklin Messenger: 'The Perception of Number.'

James Burt Miner: 'Rhythms: Motor, Visual, and Applied.'

Ida Helen Ogilvie: 'The Geology of the Paradox Lake Quadrangle, New York.'

George Braxton Pegram: 'Secondary Radioactivity in the Electrolysis of Thorium Solutions.'

Herman Simon Riederer: 'The Quantitative Determination of Bismuth as Molybdate.'

Louis Franklin Snow: 'The College Curriculum in the United States.'

Harry Beal Torrey: 'On Regeneration on Hydroids.'

Stephen Francis Weston: 'Justice in Taxation.'

HARVARD UNIVERSITY.

Frederick Bonnet: I., 'The Changing Hydrolytic Equilibrium of Chromic Sulphate'; II., 'The Compressibility of Metals.'

Charles Theodore Burnett: 'Influences on the Judgment of Number.'

David Raymond Curtiss: 'Binary Families in a Triply Connected Region, with Especial Reference to Hypergeometric Families.'

Knight Dunlap: 'Tactual Time: An Experimental Investigation.'

William Curtis Farabee: 'Hereditary and Sexual Influences in Meristic Variation: A Study of Digital Malformations in Man.'

Lawrence La Forge: 'The Geology of Somerville, Massachusetts.'

Thomas Calvin McKay: 'On the Relation of the Hall Effect to the Current Density in Gold.'

Kenneth Lamartine Mark: 'The Expansion of Gases by Heat under Constant Pressure.'

Amos William Peters: 'Metabolism and the Reaction of Division in Protozoa.'

Horatius Chamberlain Porter: 'Derivatives of Tetrabromorthobenzoquinone.'

David Camp Rogers: 'Coordinations in Space Perceptions.'

Marlow Alexander Shaw: 'Illusions of a Kinesthetic Character.'

Wilfred Newsome Stull: I., 'Association of Energy with Matter'; II., 'The Speed and Nature of the Reaction of Bromine on Oxalic Acid.'

Thomas Wayland Vaughan: 'The Eocene and Lower Oligocene Coral Faunas of the United States, with Descriptions of a Few Doubtfully Cretaceous Species.'

George Byron Gordon: 'The Serpent Motive in the Ancient Art of Mexico and Central America.'

UNIVERSITY OF PENNSYLVANIA.

Christian Carl Carstens: 'Endowments: A Study of Certain American Bequests.'

Dana Brackenridge Casteel: 'The Cell-Lineage and Early Larval Development of *Fiona marina*, a Nudibranch Mollusc.'

Homer Munro Derr: 'A Method of Petrographic Analysis Based upon Chromatic Interference with Thin Sections in Parallel Polarized Light.'

William Hastings Easton: 'The Reduction of Nitric Acid in Metallic Nitrates to Ammonia by the Electric Current.'

Franz Frederick Exner: 'The Rapid Precipitation of Metals, by the Rotation of the Anode, in the Electrolytic Way.'

Leon Wilson Hartman: 'A Spectrophotometric Study of the Luminous Radiation from the Nernst Lamp Glower under Varying Current Density.'

Burt Laws Hartwell: 'The Action of Organic Bases upon the Rare Earths.'

Carl Kelsey: 'The Negro Farmer.'

William McClellan: 'Thermo-Electric Behavior of Nickel Nitrate.'

Lewis Irving Neikirk: 'Groups of Order p^m which contain Cyclic Subgroups of Order p^{m-3}.'

James Allen Nelson: 'The Early Development of *Dinophilus;* a Study in Cell Lineage.'

Orville Paul Phillips: 'A Comparative Study of the Cytology and Movements of the Cyanophyceæ.'

George Philipp Scholl: 'The Electrolytic Determination of Manganese and its Separation from Iron and Zinc.'

Walter Thomas Taggart: 'Electrolytic Determination of Nickel and Phosphate Solution.'

CORNELL UNIVERSITY.

James Adrian Bizzell: 'Behavior of Phosphoric Acid in the Soil.'

Arthur Wesley Browne: 'Contribution to the Chemistry of Hydronitric Acid and the Trinitrides.'

William Weber Coblentz: 'Some Optical Properties of Iodine.'

Elmer Reginald Drew: 'The Radiant Efficiency of the Electric Discharge through Gases at Low Pressures.'

Jacob Goodale Lipman: 'Nitrogen-fixing Bacteria.'

Sanford Alexander Moss: 'The Gas Turbine.'

Perley Gilman Nutting: 'Ultra-violet Rotary Dispersion.'

Hugh Daniel Reed: 'The Cranial Osteology and Relationships of the Family Percopsidæ.'

William Albert Riley: 'The Embryological Development of the Skeleton of the Head of *Blatta.*'

Emil Peter Sandsten: 'Conditions which Affect the Fertility of Pollen.'

Ernest William Schoder: 'An Experimental Study of the Resistances to the Flow of Water in Pipes.'

John Edgar Teeple: 'On Bilirubin, the Red Coloring-matter of the Bile.'

George Washington Tapley Whitney: 'Recent Theories of Psychical Causality.'

YALE UNIVERSITY.

John Charles Blake: 'On Colloidal Silver and Gold.'

Wilton Everett Britton: 'Vegetation of the North Haven Sand Plains.'

Edgar Roscoe Cumings: 'The Morphogenesis of *Platystrophia;* A Study of the Evolution of a Paleozoic Brachiopod.'

William Ebenezer Ford, Jr.: 'Investigations in Mineralogy.'

Henry Franklin Merriam: 'Researches in Organic and Inorganic Chemistry.'

Helen Abbot Merrill: 'On Solutions of Differential Equations which Possess an Oscillation Theorem.'

Oscar Stoddard Pulman, Jr.: 'The Quantitative Determination of Uranium, with Applications to the Estimation of Phosphoric Acid; to which is Appended a Method for the Determination of Molybdic Acid, with Application to the Estimation of Phosphoric Acid.'

Allen Douglas Risteen: 'The Numerical Evaluation of the Absolute Thermodynamic Scale of Temperature.'

Henry Hollister Robinson: 'Geology of San Francisco Mountain and Vicinity, Arizona.'

Elias Howard Sellards: 'A Study of Some Paleozoic Plants and Insects.'

Carl Ebin Stromquist: 'On a Special Case of the Generalized Integral of Length, together with Certain Contributions to the General Theory.'

Frank Pell Underhill: 'Further Experiments on the Physiological Action of the Proteoses.'

George Benjamin White: 'Purin Metabolism and Allantoin Formation, an Experimental Study.'

JOHNS HOPKINS UNIVERSITY.

Benjamin Franklin Carver: 'A Study of New Semi-permeable Membranes Prepared by the Electrolytic Method.'

Henry Augustus Converse: 'On a System of Hypocycloids of Class Three Inscribed to a given 3-line and some Curves Connected with it.'

John P. Coony: 'A Study of Some New Semi-permeable Membranes.'

Charles Keyser Edmunds: 'Some Optical Properties of Selenium: A. Metallic Reflection Phenomena; B. Reflecting Power.'

John Gale Hun: 'The Invariant Relations of Two Triangles.'

Albert Johannsen: 'The Serpentines of Harford County, Maryland.'

George Wiles Middlekauff: 'Measurements of Certain Wave-lengths in the Spark-spectra of Iron and Titanium, Together with a Study of the Possible Influence of Capacity and Self-Induction in the Spark Circuit.'

Joseph Haines Moore: 'The Absorption and Fluorescent Spectra of Sodium Vapor.'

Atherton Seidell: 'The Precipitation of Zinc by Manganese Peroxide, with Especial Reference to the Volhard Method of Determining Manganese.'

Arthur Whitmore Smith: 'A Determination of the Heat of Fusion of Ice.'

BROWN UNIVERSITY.

Caleb Allen Fuller: 'The Distribution of Sewage in the Waters of Narragansett Bay and its Relation to the Oyster Beds.'

George Freeman Parmenter: 'The Action of Acetic Anhydride on Acids of the Phenylpropiolic Series.'

Michael Xavier Sullivan: 'Synthetic Culture Media and the Biochemistry of Bacterial Pigments.'

Ralph Winifred Tower: 'The Comparative Anatomy and Physiology of the Swim-bladder of Fishes.'

CLARK UNIVERSITY.

Roy T. Wells: 'On the Induction of Currents in Cylindrical Cores.'

Lonna Dennis Arnett: 'Ideas of the Soul.'

Fred Kuhlmann: 'Experimental Studies in Mental Deficiency: Three Cases of Imbecility (Mongolian) and Six Cases of Feeble-mindedness.'

Edgar James Swift: 'Studies in the Psychology and Physiology of Learning.'

COLUMBIAN UNIVERSITY.

Edwin Allston Hill: 'The Constitution of Oxyacids from the Thermochemical Standpoint.'

William Mather Lamson: 'On Iron and Steel Domes.'

Thomas Malcolm Price: 'The Influence of Varying Strength Solutions of Formaldehyde on Some of the Enzymes of Animal Origin.'

Harriet Richardson: 'Contributions to the Natural History of the Isopoda.'

UNIVERSITY OF MICHIGAN.

Louis Merwin Gelston: 'The Intracellular Toxins of the Diphtheria and Typhoid Bacilli.'

Mary Frances Leach: 'A Contribution to the Study of the Chemistry of the Bacillus Coli Communis.'

Mary Wheeler: 'The Chemistry of Bacterial Cells, with Special Reference to the Yellow Sarcine and the Typhoid Bacillus.'

Charles Willis Johnson: 'On the Action of Oxidizing Agents upon Morphine.'

UNIVERSITY OF CALIFORNIA.

Arthur Scott King: 'The Structure of Arc Spectra, and Some Effects of Change in Physical Conditions.'

Harold King Palmer: 'An Application of the Crossley Reflector of the Lick Observatory to the Study of very Faint Spectra.'

Joel Stebbins: 'The Spectrum of o Ceti.'

UNIVERSITY OF KANSAS.

Hamilton Perkins Cady: Chemistry.

Clarence Erwin McClung: Zoology.

LEHIGH UNIVERSITY.

Joseph W. Richards: 'A Calorimetric Study of Copper.'

Herman E. Keifer: 'A Study of Some Derivative of Meta-Diazo-Benzene-Sulphonic Acid, and the Action of certain Alcohols on Asym-Meta-Diazo-Xylene-Sulphonic Acid.'

UNIVERSITY OF VIRGINIA.

James Park McCallie: 'A Problem in Periodic Orbits, Second Order Perturbations of Jupiter and Saturn, Independent of the Eccentricities and of the Inclinations.'

J. P. Montgomery: 'On some New Compounds of Urea with Acids and Salts.'

STATE UNIVERSITY OF IOWA.

Mabel Clare Williams: 'Normal Illusions in Representative Geometrical Forms.'

LELAND STANFORD JUNIOR UNIVERSITY.

Anton Julius Carlson: 'Contributions to the Physiology of the Central Nervous System of the Snake.'

LAFAYETTE COLLEGE.

George W. Twitmyer: 'The Diagnosis and Treatment of Backward, Dull and Defective School Children.'

UNIVERSITY OF MINNESOTA.

Harold L. Lyon: 'On the Embryogeny of *Ginkgo biloba*.'

UNIVERSITY OF NORTH CAROLINA.

Royall Oscar Eugene Davis: 'The Atomic Weight of Thorium.'

PRINCETON UNIVERSITY.

Archer Everett Young: 'Isothermal Asymtotic Curves.'

WASHINGTON UNIVERSITY.

James Arthur Harris: 'The Dehiscence of Anthers by Apical Pores.'

THE SUMMER LABORATORY AS AN INSTRUMENT OF BIOLOGICAL RESEARCH.*

THERE are three kinds of summer biological stations:

I. Laboratories devoted to instruction alone. Of such a laboratory it may be said that it has no real reason for its existence. Its work can be done better, as a rule, in the existing college and university laboratories.

II. In the second place, there are some summer laboratories which are devoted to research exclusively.

III. The third class will include those combining research with instruction. Here belong our best and most flourishing institutions. The combination is good for both sides, and it is absolutely necessary to the instruction if it is to be maintained at a high standard of efficiency. The instruction may be, and in general should be, different in method and usually in subject matter from that given in the schools. In biology it is generally the natural history or ecological side which receives special emphasis, and rightly so, since these are subjects which can hardly be pursued under other conditions than those by which we are here surrounded.

I shall speak to-day chiefly of the research function of the laboratory. I do so the more cheerfully knowing the excellent record which this station has behind it in the matter of research, and having all confidence that it has a much wider future from this day onward.

The necessary conditions for research in biology fall into two great groups:

1. Material conditions—suitable buildings, apparatus, etc., a rich and diversified fauna and flora conveniently near and an environment sufficiently varied to promote ecological and experimental researches in biology. All of these conditions are obviously abundantly fulfilled in this laboratory; but I shall not attempt to enlarge upon them, as that would be to trespass on a theme better treated by our director himself.

2. There are, in the second place, certain conditions of successful research which we may term provisionally the subjective conditions. These are really of far greater importance than the material conditions, but more difficult to control. I propose that we consider some aspects of these conditions for a few minutes in the hope of gaining thereby a better insight to the real purposes of a lake-side laboratory of natural history and thus securing greater efficiency in our work here.

It is the investigator's own self—his bodily and mental organization—which is the most important instrument of research with which we have to do. Our problem, then, is nothing other than how best to bring this apparatus up to the highest state of efficiency. This laboratory, whose guests we are to-day, is clearly provided with all the material facilities for a great research center. It will make the most of these opportunities and enlarge these facilities, without doubt. Its staff is composed of tested and approved research workers. Their efficiency too is doubtless capable of further development. I ask, then, what may we expect from the laboratory in this far more difficult, yet vitally important, field of activity—the culture of the investigator himself?

Before we attempt to formulate our aims, our ideals, of what a laboratory should do for its investigators, we may properly inquire into the fundamental nature of research in general.

A few weeks ago a young man whom we may call Linton (I hasten to explain that he is not a disciple of mine) came to

* Address delivered at the opening of the Lake Laboratory, Sandusky, O., July 2, 1903.

the door of my laboratory with a parcel under his arm and asked if he might have the use of my best compound microscope for a few minutes. I invited him in and he proceeded to unwrap a dead crow which he spread out on a table and with a sharp pocket knife dissected rapidly until he had exposed certain tendons running from the bases of the primary wing feathers to the joints of the wing and thence to the sternum. Then calling attention to these tendons, he asked for his microscope. I suggested that it is not customary to use the compound microscope for that class of work and inquired whether a dissector would not be better adapted to his purpose. To this he assented and forthwith asked for my best dissecting microscope. I supplied his wants and left him. Returning in the course of half an hour I found him still examining carefully the whole length of these tendons and their attachments. Looking up he asked if I knew of any force other than that of the atmosphere and the bird's muscular movement which keeps the bird suspended in the air. Upon my replying in the negative, he proceeded to elaborate an electric theory of flight, the sternum being conceived as the generator (he reports that he has occasionally received slight electric shocks from the breast bone of freshly killed birds), the tendons shown by his dissections being the conductors and the entire surface of the spread wing being thus highly charged with electricity. At this point I ventured to inquire how the electric charge acts to keep the bird afloat. This he did not know, but thought it ought to do so.

Now, here is a bright man, full of ideas and enthusiasm, willing to do much hard labor to work out his conceptions. Why are his researches abortive, their only value being to afford a hearty laugh and a few minutes of interesting diversion in the midst of his daily grind to a jaded college professor? Here is valuable energy—for the man is no fool, he is simply untrained—going to waste merely for lack of correlation. The man is unable to put his own ideas into relation with the great body of science, and hence he is still in blissful ignorance of the fact that he has succeeded only in making a laughing-stock of himself. The most elementary knowledge of electricity would of course have shown him the absurdity of his proposition. And when we investigators of mature experience publish scientific vagaries or fantastic theories (as we all do sooner or later if we do much really creative work), our failure is traceable in the end to the same defective correlation as is Linton's electric theory of flight. So soon as the facts are all in, such excrescences of scientific fancy are trimmed off automatically.

If now we attempt to interpret research in terms of the current dynamic conceptions of consciousness and of things in general, we may conveniently subdivide the history of any given special investigation somewhat as follows:

I. We have first the preliminary steps which we may characterize, to borrow a medical term, as the prodromic stages. These include the investigator's whole previous life, the sum-total of his experience so far as it has affected his mode of thought and his fund of ideas. His consciousness may be conceived as for the moment in a state of relatively stable equilibrium. This equilibrium, however, is not perfect. His fund of knowledge is not complete, nor even symmetrically incomplete, but it is full of gaps.

To some men these gaps are not significant. Their phenomenal world is completely filled (no matter how contracted their horizon), as one fills out automatically and unconsciously the blind spot on his

own retina. Such people never become investigators.

To some other people, on the other hand, every break in the continuity of our knowledge is a distressing thing; merely to state a problem is to call into being a center of unrest. Our investigator manifestly is of this type. He looks at the world as in a broken mirror, full of irregular gaps and distortions, every one of which is to him more or less painful. We can not therefore speak of the resting stage of his consciousness as in perfectly stable equilibrium.

II. In this condition he receives some impression—let us say, to take an illustration from my own recent experience, a peculiar movement of the catfish hitherto unobserved—which serves to direct attention to some one of these tender spots of consciousness, in other words, to some biological problem. The known facts bearing on that problem become focalized in the investigator's mind, and that which was before a consciousness in relatively stable equilibrium becomes a tensional system in very unstable equilibrium—it becomes, in fact, at-tention.

Our student has now selected his problem, let us say the function of certain cutaneous sense organs upon the barblets of the catfish, the stimulation of which he supposes may have occasioned the peculiar movement above referred to.

We are in the habit of saying that the 'research' now begins; as a matter of fact the research is already well under way. Well begun may be more than half done in this case. The meaning of the problem and the value of its solution will be determined by the character of the initial tensional system, and this in turn rests upon the investigator's wealth of mental content in what I have called the prodromic stage—in common parlance, upon his preparation for research. The observed fact in the beginning would have suggested no problem unless his previous fund of experience had permitted a prophetic insight into its meaning—'in-sight' as distinguished from 'at-sight,' or the meaningless gaze of the untutored mind, to use a happy antithesis of Dr. Paul Carus.*

III. Now, tension means dis-harmony. The solution of the problem involves the release of this particular tension in consciousness and the return to equilibrium, or the correlation of the new fact observed with the preexisting body of fact. The probability is that this can not be done directly; they do not fit together. The student now proceeds to accumulate new facts suggested by those already known, with the expectation of being able finally to complete the system, effect the correlation, and so relieve the tension. This is observation and experiment.

His fish, to return to our illustration, is placed under experimental conditions and its reactions noted under a great variety of modes of stimulation, the observer's mind being always alert for an observation which correlates with facts previously noted.

IV. This process involves the dissociation so far as possible of fact and meaning, of observation and interpretation, and this dissociation in consciousness of things which in nature actually belong together *is* the tension. The facts must be objectified, personal equation must be eliminated or allowed for, prejudice avoided, and when the series of facts as thus objectified is sufficiently complete so that fact hangs with fact and the whole forms a natural unit, then the interpretative series (which in the first place set the direction of the research) again becomes dominant, fact and interpretation fit to-

* In the 'Primer of Philosophy.' Cf. the 'intuition' *vs.* 'at-tuition' of Laurie.

gether, the tension is relieved, correlation is effected, the problem is solved.

The student finds, for example, that the observed reaction of the catfish under consideration is produced by the chemical stimulation of certain taste buds on the barblets; in other words, that the fish tastes with the barblets as well as with the tongue. The steps in the observational series are these: The movement made when the barblets touch food is to turn and snap up the morsel and swallow it. It is a sensori-motor reaction similar to those from the eye and nose. This is our first correlation. It is not a tactile reaction, because it does not occur after contact with a tasteless object such as gelatin. In the same way the participation of other sense organs may be experimentally eliminated until chemical stimulation (taste) is left as the only possibility. It is a fact of observation that there are sense organs on the barblets which resemble in structure the taste buds in the mouth; the two groups of sense organs are known to be supplied by similar nerves both of which are connected with the gustatory centers within the brain. Experiment now shows that the two sets of sense organs have a similar function, and the coordination of our factual series with the interpretative series is complete—the reaction is a gustatory reaction.

The working hypothesis in the research from this point of view is an anticipation of the 'meaning' of the factual series in advance of the discovery of all the facts. The value of the hypothesis is simply to point the direction for the accumulation of further facts. If a coherent series of facts can be found which coincides with the provisional explanatory series, the solution is found; if not, another provisional explanation must be produced.

In all these cases the test of fitness is the coordination of fact with fact, and fact with explanation. That done, the gap in our knowledge is filled, our world of knowledge becomes by so much larger, and the painful tension of disconnected experience gives place to the satisfaction of correlation and integration of the new with the old and consequent broadening out of the meanings of life, which is really creative work. In proportion as the newly acquired facts and interpretations can be broadly correlated with the existing fund of knowledge, in just so far is the research really great.

Now the ability to make this correlation at the end is the same kind of ability as that which is necessary at the beginning to get the good 'point of view' from which to choose a fruitful problem and shape efficient working hypotheses. No liberality of financial endowment, no profusion of material equipment, no wealth of faunal and floral environment, will compensate for its absence. Nothing can come out of the place which is not inherent within its men. Our first aim must, then, be to safeguard the investigator himself.

To return, then, to our theme, there are very practical ways in which the summer laboratory may contribute, as no other can, to the culture of the investigator himself, and it is this function which I conceive to be the most important justification for its existence.

Most of us who go from home to these biological stations leave well-equipped laboratories of our own, and not infrequently the particular research in hand can actually be done more conveniently at home than abroad. It has been my custom for years, at the beginning of the summer, to pack up my slides and other research materials and carry them at considerable expense of time and money to a seaside laboratory where two or three months are

spent, not in the study of marine types, but in the elaboration of my collections made in Ohio and for which my own laboratory furnishes the necessary equipment better than those to which I have made my annual migrations. Nevertheless, I have always felt that the time and money so spent were profitably invested—indeed the expenditure has actually been necessary to the highest efficiency of the research.

The apparent paradox is fully explained when it is remembered that the man can put into the research no more than he has in himself. The investigation is no external thing which he makes; *it is his life,* and the man must first be broadened, deepened and rounded out, if this manifestation of his inner life is to have real power, is to become an efficient factor in the world's work. This the summer laboratory can do, and can do with small material outlay, if only we go at the thing in the proper way.

Most of us are closely shut up during the nine months of the school year in the confined atmosphere of our own laboratories, often in almost total isolation from our confrères with whom we are (or should be) collaborating in the prosecution of our researches. In such a case one naturally slip into ruts, and sooner or later, unless the situation is relieved, his work will give evidence of a mildew, or perchance a dry rot will permeate his best work, so that freshness, originality and virility gradually give place to dreary routine or to grotesque fantasy.

That this is not the inevitable outcome of the sort of solitary confinement to which many investigators, particularly those in the smaller colleges, are of necessity condemned is clear from the history of many of our most illustrious research workers whose most valuable contributions have been produced under just these conditions. But the fact remains, that just in proportion as our work will prove of real and permanent value, we must keep ourselves in touch by some means or other with the outer world, with the current tendencies and advance movements of research in cognate lines. This can of course be done in great measure through the medium of the press, but nothing can take the place of real, vital contact with other investigators in the fiesh. Here we get not only inspiration and stimulus in general, but often items of direct value to our own work years in advance of their publication.

The summer laboratory should be a clearing-house of scientific ideas, not merely a hotbed or forcing house for budding researches. To meet this need it is evident that the greater the diversity in personnel and range of interests represented the better. That which the university student prizes most is the intimate daily contact in the lecture room and laboratory with his instructors. In the properly organized summer biological station every worker comes into that same sort of relation with every other worker, and this, I take it, is the best that the station can offer to its patrons. To attain the highest efficiency there must, therefore, be sufficient flexibility of organization and diversity of interests represented to correct the tendencies toward intellectual in-breeding which we find in most of our university and college laboratories and to secure a sort of cross-fertilization of scientific organizations.

Regardless of the individual investigator's problem and method, he can well afford to utilize such opportunities; indeed he can not afford, except in unusual cases, to neglect them for long periods, if he would retain his intellectual tone and elasticity. The station, in short, is an

exceptionally favorable aid in effecting that breadth of view and perfection of coordination which we have seen to be the keystone in the arch of scientific achievement.

It is a source of congratulation to us, the members of this laboratory, that these liberal principles are clearly at the foundation of our present organization. Our director has made it very plain, not only by word of mouth, but much more forcibly in practical ways, that it is to be the policy of our laboratory to secure the widest cooperation among all the men of science of our state. To this, as the representative of organized science in Ohio, I have pleasure in responding with equal cordiality that it will be our purpose to share in the great work here established to the full extent of our ability, by attendance when possible, and by sympathetic interest at all times. While we are the gainers by this liberal hospitality offered by the laboratory, it is certain that the laboratory in thus casting its bread upon the waters will find it again after many days.

Permit me in closing to quote a paragraph from the article recently published in the special Christmas number of *Mind!* entitled, 'Specimens of the Critique of Pure Rot, from the remains of a Philosopher, by I. Cant.' "Let us begin by inquiring into the possibility of Rot in general. That Rot exists you may take my word. And there are two kinds of it: damp rot and dry rot, besides certain fungoid growths." To which of these categories this effort of mine belongs, I leave you to judge—whether it is damp rot or dry rot, or merely a relatively innocuous fungoid growth which will deliquesce with the rise of tomorrow's sun.

C. Judson Herrick.
Denison University.

*THE INTERNATIONAL CATALOGUE OF SCIENTIFIC LITERATURE.**

It may be well to briefly outline the history of the International Catalogue of Scientific Literature before recounting the condition of the work at present.

The original suggestion of an international catalogue came from Professor Joseph Henry, first secretary of the Smithsonian Institution, who in 1855 called the attention of the British Association for the Advancement of Science to the great need of a work of this kind. The idea was in advance of the times, and not until 1867 did it bear fruit in the publication by the Royal Society of the well known 'Catalogue of Scientific Papers.' In this publication Professor Henry was given due credit as the originator of the idea, but the work itself was only in part the realization of his plan, dealing as it did with serial publications only and indexing them by authors' names alone. However, with this start the plan lived and progressed until 1894, when the Royal Society, feeling that the time had come to improve the plan of their catalogue, and assured that this could be effected only by international cooperation, addressed a circular to the learned societies of the world, bringing the matter to their notice. By the advice of the societies responding to this circular the Royal Society through the British Foreign Office invited the governments of the world to send delegates to a conference to be held in London in 1896. At this and the two following conferences of 1898 and of 1900 the plan took shape and it was decided to start the work with a classified subject and author catalogue of all original scientific literature beginning with January 1, 1901. The following named sciences were to be included within the scope of the catalogue, one volume a year being devoted to each of

* Read before the Bibliographical Society of Chicago.

the following seventeen sciences: Mathematics, mechanics, physics, chemistry, astronomy, meteorology (including terrestrial magnetism), mineralogy (including petrology and crystallography), geology, geography (mathematical and physical), paleontology, general biology, botany, zoology, human anatomy, physical anthropology, physiology (including experimental psychology, pharmacology and experimental pathology) and bacteriology.

The organization was to consist of a central bureau in London to edit and publish classified references to the current world's literature furnished by regional bureaus established in and supported by the principal countries of the world. After much discussion a system of classification was adopted which divided each science into specific, numbered subdivisions under one or more of which it is possible to classify any paper on any subject within the domain of science. Conversely, when any subject is to be investigated the plan is first to find the subject-heading in the classification schedule and to use the number there given instead of a page number in looking up the grouped references in the body of the catalogue, the pages of which bear the schedule numbers in addition to page numbers. As, with the exception of additions, these subdivisions and numbers are the same from year to year, this method will materially aid in investigations covering a term of years.

Full histories of the conferences have been published by the Royal Society in three pamphlets entitled, respectively, Reports of the proceedings at the first, second and third international conferences on a catalogue of scientific literature. Brief accounts by the writer of this paper covering the history of the enterprise from its beginning through the second conference have been published in SCIENCE, August 6, 1897, and June 2, 9, 1899.

When the third conference had finally decided to begin the work, many of the delegates attending were empowered by their governments to promise official aid to the undertaking, but although Congress had been petitioned to aid in the matter, no action had been taken and the United States, therefore, was unrepresented.

Regional bureaus were established in the following countries: Austria, Belgium, Canada, Cape Colony, Denmark, Egypt, France, Great Britain and Ireland, Germany, Greece, Holland, Hungary, Italy, India and Ceylon, Japan, Mexico, New Zealand, New South Wales, Norway, Portugal, Poland, Queensland, Russia, South Australia, Sweden, Switzerland, Victoria, Western Australia and Finland. Authority over all questions of methods and administration is vested in an international convention to be held in London in 1905, 1910 and every tenth year following.

Failing in governmental appropriation, the Smithsonian Institution felt obliged to render its fostering aid to the project in the United States, otherwise the whole enterprise might have been abandoned. The Institution was at the time enabled to devote a sum of money to carry on the work here provisionally, which, together with gratuitous aid, rendered it possible to make a start. Up to the present time the very limited means at the disposal of the Institution has greatly hampered the work here. However, beginning with July 1, 1903, the force employed will be increased, as it has been possible for the Institution to devote a sum of money to this purpose which has heretofore been otherwise employed. This will not only enable the Institution to deal properly with the current publications in the United States, but will render it possible to make good the omissions occurring from January 1, 1901, to the present time.

Congress has been approached on several occasions in the endeavor to have the

United States officially take its place with the other great nations in this work, but though the Department of State has on four occasions strongly recommended to Congress the advisability of making a suitable appropriation for the work, to be expended under the direction of the secretary of the Smithsonian Institution, no appropriation has as yet been made and it is feared that, owing to the growing disposition on the part of some members to oppose all grants for purely scientific work, the hope of future aid from this source is not encouraging.

On account of the necessary delays attending the beginning of a work of this kind, only the index of part of the first year's literature has so far been published. To be more exact, nine complete and three part volumes of 1901 are now published, besides a list of journals.

It was at first hoped that valuable aid could be obtained from existing card indexes in the different scientific branches of the government, but experience has shown that, owing to the dissimilar methods used, it is practically as difficult to transpose, verify and properly classify the references obtained in this manner as it is to obtain the data at first hand. The Geological Survey, however, has aided greatly in the preparation of the volumes on mineralogy, geology and paleontology, and much valuable aid has been had from the Library of Congress and the Hydrographic Office, besides the bureaus immediately under the Smithsonian Institution. Especial recognition is due to Dr. Theodore Gill, whose ever-ready advice in all mooted questions relating to zoological taxonomy has rendered aid such as could only be had from an authority whose decisions are beyond question.

To give some idea of the extent of the work in this country I may say that approximately twenty thousand classified reference cards have been forwarded by the Smithsonian Institution to the London Central Bureau. Of these over thirteen thousand dealt with the literature of 1901.

The method here employed is briefly this: A numbered card record file is kept of the titles of the periodicals published in the United States which are likely to contain matter on scientific subjects; this record is systematically gone over at regular intervals and the periodicals called for from the Smithsonian Library which aims to receive all such publications. The contents of the publications themselves are indexed separately on cards, and each card duplicated as many times as necessary in order to send to the Central Bureau (besides the regular reference by authors' names) one card for each of the subjects into which the paper is classified. Duplicate author reference cards on which are noted the assigned classification are kept for file, and a record kept of the entire publication on the periodical cards already referred to. By this method it is possible not only to duplicate the work at any time but to check and make good any omissions.

Separate publications and books are treated in like manner in regard to classification, although the methods of obtaining notice of their appearance is necessarily different.

To classify properly into minute subdivisions, such as are employed in this work, the vast amount of scientific matter appearing in this country is a difficult task, but every effort is used to make the references exact, and where there is any intricate question involved the advice of a specialist is asked. I desire to acknowledge the valuable services of Mr. L. C. Gunnell and Miss Rose A. Palmer, who have brought intelligence, enthusiasm and industry to the work of indexing and classification. At the central bureau a corps of referees

are employed, a specialist for each science, who, to guard against error, review each reference before publication.

It is a matter of congratulation that this country leads in the number of subscribers to the catalogue, the number being 96, equivalent to over 70 complete sets. The individual volumes may be subscribed to for a sum *pro rata* to the cost of the full set. As the yearly subscription to the full set of seventeen volumes is $85, this is an encouraging showing. Although this catalogue has not been free from the defects and consequent criticism attending all new enterprises, the work itself is being done in a way to furnish a helping hand to both librarians and students who have long needed a concise subject index to the great and ever-increasing scientific literature of the day. This field the International Catalogue of Scientific Literature aims to cover.

CYRUS ADLER.

SMITHSONIAN INSTITUTION,
June 19, 1903.

SCIENTIFIC BOOKS.

NEW TEXT-BOOKS IN PHYSICS.

A Laboratory Manual of Physics. By HENRY C. CHESTON, PHILIP R. DEAN and CHARLES E. TIMMERMAN. New York, American Book Company. 1903. Pp. 128.

Laboratory Exercises in Physics. By GEORGE R. TWISS. New York, The Macmillan Company. 1902. Pp. 193.

A Manual of Elementary Practical Physics. By JULIUS HORTVET. Minneapolis, H. W. Wilson. 1902. Pp. 276.

Practical Physics for Students of Science and Engineering. By ERVIN S. FERRY. LaFayette, Ind., Burt-Terry-Wilson Co. 1903. Part I. Pp. 146.

Mechanics, Molecular Physics and Heat. By ROBERT A. MILLIKAN. Chicago, Scott, Foresman & Co. 1902. Pp. 242.

Elements of Physics. By FERNANDO SANFORD. New York, Henry Holt & Co. 1902. Pp. 426.

Elements of Physics. By ERNEST J. ANDREWS and H. N. HOWLAND. New York, The Macmillan Company. 1903. Pp. 386.

Introduction to Physical Science. By ALFRED PAYSON GAGE. Boston, Ginn & Co. 1902. Pp. 359.

Text-Book of Physics. By R. A. LEHFELDT. London, Edward Arnold. 1902. Pp. 304.

Light, for Students. By EDWIN EDSER. London, Macmillan & Co. 1902. Pp. 571.

Lehrbuch der Physik; Erster Band, Mechanik. Von O. D. CHWOLSON, St. Petersburg; übersetzt von H. PFLAUM. Braunschweig, Friedrich Vieweg und Sohn. 1902. Pp. 791.

The annual crop of new text-books of physics is becoming so large that the bewildered reviewer is scarcely able any longer to discuss them distributively; or, if so, it has to be by some system of grouping with comparison of the members of each group. A threefold division may perhaps be made according to the apparent aims of the authors. The first group consists of those which are intended for use chiefly or entirely in the laboratory. The second is made up of those adapted for class-room use in connection with oral exposition. The third includes books intended neither for the laboratory nor for the class-room primarily, but as systematic presentations of principle, to be mastered by private reading in courses of parallel study accompanying the formal lectures or in preparation for formal examinations.

To the first group distinctly belong the first four books of the present list. In the preparation of an elementary laboratory manual there is no longer much range for great originality or for adaptation to a large clientage. The first volume is a little book of 128 pages, prepared by three authors, who frankly begin by saying: "The reason for adding this book to the large number of laboratory manuals is that those now in use either contain too much matter to be successfully covered by a pupil in one year, or elaborate the principles chosen without regard to economy in time." The authors of the other manuals may perhaps differ with these authors as to what constitutes too much matter and in regard

to economy of time. Everything depends upon the special circumstances to which each author has to adapt himself. Any laboratory teacher will probably be able to extract something useful from any laboratory manual if he is alert. Instructions must be well methodized and put into good form, but in no case can they be a complete substitute for the instructions needed in any laboratory other than that in which the given manual was developed. The volumes by Mr. Twiss and Mr. Hortvet are, like the first, good examples of method, all of them being intended for secondary schools, but containing material that can be utilized by beginners in college. Their purpose is, as well expressed by Mr. Hortvet, 'to teach pupils to measure accurately, to manipulate carefully, to work methodically, to see fully, to reason intelligently and to express their observations and results clearly.' It would be an untold blessing to all students of science, irrespective of age or specialty, if such ideals were unceasingly kept in view and even approximately attained.

The small volume by Professor Ferry is the first of a series consisting of four parts, the second of which is now in press. They are intended for students who have a distinct object in view, that of preparation for the profession of engineering. They are, like all such books, the outcome of local needs, where a large number of students require simultaneous attention. The aim is 'to furnish the student with a laboratory manual of physical processes and measurements in which the explanation of the theory and the description of the method of manipulation of each experiment is so complete as to preclude the necessity of consulting either another book or a laboratory instructor.' Doubtless there are many besides the reviewer who have been doing just this task for years past. Hundreds of pages of manuscript have been prepared, some of which are discarded every year, while the need of new instructions adapted to changing conditions is periodically presenting itself. Many of the details of routine may be confided to assistants, but the calls upon the laboratory director will cease only when he gives up his post. Nevertheless the method is on the whole economical. It saves much repetition; it enables the slow student to study out difficulties with a minimum of personal aid; it tends to make him appreciate the advantage of depending on himself to supplement by thought whatever shortcomings may seem to exist on pages prepared for the average student rather than for any single individual. Professor Ferry has done his work with much skill, showing on every page his decided possession of the teacher's instinct. If he should find, by the time the fourth volume is out of press, that the first volume is much in need of revision, because of expansion and other changes in his laboratory, he will at least enjoy the satisfaction of having much good company in patiently performing the labor of Sisyphus and doing it well.

Dr. Millikan's book is a presentation of part of the work in general physics given to first-year students at the University of Chicago. It presupposes the possession of an abundance of apparatus of fine quality, all of which is thoroughly modern, and much of which has been designed and made initially for the Ryerson laboratory. The book is a combination of laboratory manual with class-room text. There are many teachers, therefore, to whom, on this account, the present volume will partially fail to commend itself. On such a subject no procrustean rules can be laid down, but each teacher must work out for himself the system of instruction by which he can attain the best results. Dr. Millikan's method is to divide his time nearly equally between class-room and laboratory work; but the former is wholly occupied with the discussion of the principles presented in the text and their application to practical problems. No demonstration lectures whatever are given until the last third of the year, when there is offered a discussion of those topics that have been omitted from the preceding courses because what is known about them is largely qualitative rather than quantitative. Such subjects as electrostatics, electric radiation, physiological optics and acoustics, the radiation, absorption, polarization and interference of light, are hence deemed suitable for initial

presentation in the lecture room rather than the laboratory. The student is assumed to have already completed a good high-school course, and the aim is not so much to acquaint him with interesting phenomena as to put him in touch with the methods and means of physical investigation. Whether the book can be profitably used by teachers of physics generally, by putting it into the hands of their students, it is not possible to make any positive assertion; but it can not fail to be very suggestive and otherwise useful to all whose range of duty coincides even in part with that of the author.

Professor Sanford's book is like that of Dr. Millikan in one important particular, that it is intended jointly as a presentation of theory and a laboratory guide. He believes the lecture-room method of imparting knowledge to be the poorest of all methods with elementary students, and his book has been written with the idea that it will not need supplementing by a lecture course. "It has been prepared especially for the teacher who has had an adequate training in the physical laboratory, and it is not likely to succeed with any other teacher." It is issued more especially for California students of high-school grade who compose a majority of the applicants for admission to the Stanford University; but it is evidently best suited for that increasing proportion of high schools in which the work encroaches largely on that of the college, and which seem destined within the next generation to supplant the small college in all except the thinly populated parts of our country. The author lays much stress on the importance of following in the laboratory the general method of scientific discovery, in which the acquisition of individual facts must precede generalization, while this in turn is followed by deduction and such special experimentation as is necessary to test its validity. Among the salient features of the book are the attempt to base the initial development of mechanics consistently upon the concept of energy, the discussion of the gaseous state of matter as a preliminary to that of the liquid and solid states, and in optics the complete elimination of 'the fiction of rectilinear propagation.' This last is a self-imposed and quite unnecessary limitation. If we admit the wave theory and the existence of wave fronts in a medium with known properties, the direction of propagation becomes as recognizable as the wave front, and it can scarcely be called a fiction unless the medium is also fictitious. The luminiferous ether may perhaps be still called a fiction, though one of great convenience and an intellectual necessity at present. Whether the wave front method or the ray method of explaining optical phenomena be preferred is a matter of convenience or of fashion. There can be no inconsistency in using both or either at will, and certainly each has its own advantages.

The volume by Messrs. Andrews and Howland presents no such departures from prevailing usage as the two just noticed. It is well balanced, well arranged and clear in style, but it contains no features that have not been exemplified in some of the better elementary class text-books in common use. The general plan of the authors has been to eliminate subjects that are of mere theoretic interest and to emphasize those that are practical; to use the simplest language possible and to avoid mathematical formulas in all cases where these are not absolutely necessary; to show as much as possible, for every subject selected, its relation to fundamental principles or their obvious corollaries.

Gage's 'Introduction to Physical Science' is a revised edition of a book that has been on the market since 1887. The author was at that time the well-known champion of the idea, at present advocated anew by Professor Sanford, that the student must be an inductive investigator. Mr. Gage now fully recognizes 'the consensus of opinion among teachers of physics that the method of instruction which includes a due proportion of text-book study, lecture-room demonstration and individual work in the laboratory is the method conducive to the highest order of results from an educational point of view.' The present volume is essentially a class text-book, and not a laboratory manual or a reading book for parallel private study. It is

scarcely necessary for the present writer to repeat what he has said in commendation of Mr. Gage's skill as a text-book writer, manifested in other books reviewed in the columns of Science. He is fully up to the standard set in those volumes.

The third group of text-books, intended for parallel reading or private study, is exemplified by the last three books on our list. This, perhaps, might be expected from the fact that the authors are writing for readers on the other side of the Atlantic, two of them being English and the third a Russian. There has been a distinctly American evolution of educational methods; and this fact, quite independently of any author's individual merit, causes few foreign text-books to be now available for text-book purposes in American schools, except for advanced students.

Lehfeldt's 'Text-Book of Physics' is written for students of medicine, and the author has endeavored, therefore, to exclude mathematical formulas as much as possible. The mode of arrangement is not to be commended, there being many long paragraphs and but little to aid the reader in singling out salient points. It is impossible to avoid formulas entirely, and these are incorporated quite frequently in the midst of the paragraphs, instead of being put separately and equationally so that mutual relations may be readily perceived. The book contains no problems. Chapter VI., entitled 'Chemistry,' is made up wholly of paragraphs in fine print on such subjects as the law of mass action, the phase rule, thermo-chemistry, and the relation of heat to chemical equilibrium. A single paragraph of this fine print, considerably more than a page in length, consists of seventeen sentences. The book was written with a view to attracting attention to the intimate dependence of physiology on physical principles, and is made up of the author's lectures to students preparing for the intermediate examination at London University.

Edser's 'Light for Students' is written by one who is far better versed in the art of book-making. The paragraphing is good. The illustrations, chiefly diagrams with white lines on a black ground, are clear and well selected. Mathematical formulas are used wherever necessary, and the deduction of them is usually in good shape, no knowledge of calculus being assumed. In discussing the wave theory the author recognizes the rectilinear propagation of light, not as a 'fiction' but as a resultant of wave motion, and light rays are assumed equally with wave fronts whenever suggested by convenience. Among the illustrations are several selections from Professor Wood's excellent photographs of air waves taken by the 'Schlieren-Methode.' Modern advances are noticed, including the production of stationary light waves by Wiener and Lippmann, the interferometer work of Michelson, and his echelon grating. The light phenomena accompanying electric discharges in high vacua come in for attention, X-rays being regarded as probably those of ultra-violet light of extremely short wavelength. The radiation from salts of uranium, polonium, actinium and radium is mentioned, but as the date of the preface is September, 1902, this subject is noticed more briefly than it would be to-day. The book is, on the whole, much to be commended.

The first volume of Chwolson's 'Physics' was published in 1897, at St. Petersburg, in the Russian language. A second edition appeared in 1900 and was brought to the attention of Professor Wiedemann at Erlangen. Appreciating its excellence, he took steps to secure its translation into German. This task was undertaken by Dr. Pflaum in Riga and the risk of publication assumed by Vieweg in Braunschweig.

Of late years two notable books on chemistry have come from Russians, the one by Mendelejeff, the other by Menschutkin; but neither could exert any important influence on the scientific world until freed from the shackles of an unspeakably difficult language. Chwolson's book is now in process of similar deliverance, and it has already received marked attention in Germany. The first volume, of nearly 800 pages in German, relates to the mechanics of gases, liquids and solids. The second, on acoustics and radiant energy, was to appear in Russian in 1898. The third relates to heat, and the fourth to

magnetism and electricity. The book has been written to meet the needs of university students, and in the first part it is assumed that the student has not yet had an opportunity to become acquainted with the methods of calculus; but this assumption is soon discarded.

The range of the first volume may be briefly indicated by an enumeration of subdivisions. After an introduction of fifty pages come the subjects of motion, force, work and energy, harmonic motion, radiant propagation of vibratory motion, universal gravitation, the potential theory, gravity. Then follows a section on instruments and methods of measurement, and separate sections on the theory of gases, theory of liquids and theory of solid bodies, the last including a discussion of elasticity and of friction. The style of presentation is clear and direct, and frequent brief summaries help the reader to seize upon fundamental principles. Each section closes with an index of literature relating to its subject matter.

Quite possibly the state of the American market may not warrant the translation of this excellent treatise into our language, but it is well worth the attention of those who are sufficiently interested to examine the German edition. W. LECONTE STEVENS.

SOCIETIES AND ACADEMIES.

BIBLIOGRAPHICAL SOCIETY OF CHICAGO.

A REGULAR meeting of the Bibliographical Society of Chicago was held in connection with the annual meeting of the American Library Association on the afternoon of Wednesday, June 22, at Niagara Falls. After the president's address by Mr. A. G. S. Josephson, a paper on the 'International Catalogue of Scientific Literature,' by Dr. Adler was read. This paper is published above.

Dr. Herbert Haviland Field, of Zürich, was introduced and gave an account of the Concilium Bibliographicum founded in Zürich by the third International Congress of Zoology, in 1895. This institution collects and records all publications in biology, giving to each article separate cards of Library Bureau size. These cards aggregate at present twelve million for 150,000 titles, and thus constitute one of the largest, if not, indeed, the largest, collection of printed bibliographical cards. The Concilium Bibliographicum regards it as a technical triumph to have produced these cards for sale at the low price of one fifth cent per card. The cards are classified according to a methodical classification which is a development of the Dewey decimal system. For each topic found in the various publications there is a separate card published. In determining the various entries the text and not the title of the publication is considered, the number of entries for a single work often attaining ten or twelve. Besides supplying libraries and other institutions with complete sets of cards, the Concilium permits individual investigators to order cards for their own specialties. Thus the traveler going to Borneo could apply for the cards dealing with the fauna of Borneo. He would receive these at a nominal charge. In like manner any topic of investigation whatsoever can be asked for. The Institute is to-day nearly self-supporting, though it receives an annual subsidy of $1,500 from the Swiss Federal Government. It confidently hopes that bibliographers in America will lend it their support in obtaining similar financial aid in the United States.

Mr. Wilberforce Eames, of the Lenox Library, New York, presented a report in favor of the formation of an American Bibliographical Society and recommended that the Bibliographical Society of Chicago be authorized to take the initiative in the formation of the society. The report was adopted and active steps toward organization will be taken in the fall.

CHARLES H. BROWN,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE ST. LOUIS CONGRESS OF THE ARTS AND SCIENCES.

TO THE EDITOR OF SCIENCE: In the May number of the *Atlantic Monthly* there appeared an article by Dr. Hugo Münsterberg, giving, in a quasi-official manner, a statement of the plans for the St. Louis Congress of

the Arts and Sciences. The fact that a literary rather than a scientific journal has been selected as a means of communication to the public, and that the plan itself as there set forth is philosophical rather than scientific, affords my justification for writing on a matter which my own technical scientific qualifications would under ordinary circumstances hardly entitle me to discuss, excepting possibly as respects one group of the sciences.

That the article bases the working plans of the St. Louis Congress of Arts and Sciences upon a particular methodology emanating from a particular school of metaphysics, not as yet numbering among its adherents any great number of either scientific men or philosophers, naturally arouses certain apprehensions. I write chiefly in the hope that some explanation may be forthcoming which will allay these apprehensions, which I find I am far from alone in feeling. Even after the explicit statements of the article, one can hardly believe one's own eyes, and is sceptical of one's right to attribute to the distinguished committee the notion of basing the Congress upon a particular scheme of metaphysical logic. One is sure the plan must be capable of construction in some other way. Accordingly I beg in advance the pardon of the committee if I should attribute to it in my following remarks a plan which as a matter of fact it has not fathered.

1. The article begins by setting forth an idea which is rational and feasible, and which would probably command general if not unanimous assent; the idea that the Congress should concern itself with the general aspects and bearings of the sciences, their relations to each other and to the unity of human knowledge and endeavor, rather than with purely specialized questions and researches.

2. Apprehension begins when we read: "The natural condition would be a plan in which every possible striving for truth, every theoretical and practical science would find its exact place. * * * It must be really a plan which brings the inner relation of all branches of knowledge to light * * * a ground plan which would give to every section its definite position in the whole system" (p. 674 of the *Atlantic Monthly* for May, 1903). It is repeatedly stated that the chief feature of the plan is that the arrangement of the sciences chosen is not one of practical convenience or effectiveness, but is one based upon a logical theory of knowledge. It is hardly necessary to point out the radical difference between a Congress which should work along the lines of the generalized aspects and interests of the sciences, and a Congress based upon a previously formulated and predetermined scheme of the unity of knowledge, or to dwell upon the *nonsequitur* from the first notion to the second. It is not the Congress of scientific and philosophical workers which is to bring to light (or bring nearer to the light) the unity and interrelation of the various movements of contemporary intellectual life. No, a necessary precondition of the work of the Congress is that it follow the lines of a predetermination of what the unity really is, a notion foreordained by a committee in charge of the Congress! One naturally asks the pardon of the committee for attributing to it even the passing fancy of a scheme at once so presumptuous and so futile.

3. As we read further we learn that this precondition of a 'ground plan' has been met, the committee having officially adopted a 'ground plan.' From the historical point of view, we learn from the article that contemporary intellectual life is officially decreed by the committee to have got beyond materialism, positivism, psychologism, indeed beyond any scheme in which the mental and physical sciences are coordinated with each other. The practical bearing of this appears when we are told that each department is to have an address on the historical development of its own line of work in the last century. It will certainly tend to decrease intellectual labor that each speaker know in advance the 'ground plan' of development which his own group of sciences has followed in the last century. There are still those, however (of whom I confess myself one), who would prefer to gather their ideas of what the actual historical move-

ment of the century has been from the results of the deliberate investigations of scientific leaders in a large number of fields, rather than to accept the conclusions of even so distinguished a body as the committee which has framed the plan for the Congress.

4. The 'ground plan' is also set forth in its logical scope and symmetry. There are five classes of sciences; the divisions being based upon the distinction, first between 'purposes' and 'phenomena,' and then between such purposes and phenomena as hold good for the individual and those which are more than individual in quality. There is we learn a radical gulf between purposes and phenomena. Purposes 'are not to be explained but to be interpreted' (*sic*, p. 677); they represent values which are to be appreciated, not described; they are to be approached by teleological not by causal methods (pp. 676–677). The student of art, history, literature, politics, jurisprudence, education, is, we are told, occupied with matters of this sort. Just what will happen to those students of art, history, politics, education, etc., who persist in considering that their concern is with phenomena, with their description and explanation, and who are desirous of employing psychological methods in this description and explanation, we are not told. Then 'phenomena and purposes' both subdivide themselves; each branches into those facts which are individual or hold only for one subject, and those which hold for every possible subject. The sciences which deal with the individual *phenomena* are the mental; those which deal with individual *purposes* are the historical. The sciences which deal with more than individual phenomena are the physical; those which deal with more than individual purposes are the normative, viz., metaphysics, logic, ethics and mathematics. Then we have a fifth class of sciences: those which deal with the relations between 'physical or mental, normative or historical facts on one side, and practical ends of ours on the other' (p. 678).

While it is somewhat confusing to discover in this fifth classification that purposes and norms turn out to be only facts, after all, and that even after we have gone through the sciences devoted to norms and purposes there still remain practical ends to be dealt with, yet the point that I here raise is not that of the ultimate value or final truth of this classification. The point is that it is a scheme characteristic of one limited school of philosophical thought. The real question at issue is the wisdom of basing a world's congress of arts and sciences upon any sectarian intellectual idea representing some particular *a priori* logic. Why should the committee take it upon itself to define the constitution of the unity of human knowledge, and to provide ready-made a plan or map of the interrelation of all its parts? Why is it not the business of the scientific and philosophical workers called together from all parts of the earth to consider, collate and present their own ideas about the structure and the divisions of the unity of human knowledge? Is it not the business of such a congress to further a consensus of judgment, or at least of inquiry, regarding just the features which the committee, according to the *Atlantic* article, has seen fit to prejudge and forestall?

One might also raise the question whether any scheme has a right to arrogate to itself the title of a 'ground plan' of the *unity* of human knowledge whose final result is to separate the psychological sciences from logic, esthetics and ethics, to separate all of these from the historical sciences, and the historical sciences in turn from the sociological sciences, and then to set up a fifth division of practical sciences to furnish 'links' for what has thus been chopped up! It would involve discussion of the merits of the particular plan proposed to argue that any plan which terminates in such arbitrary divisions has thereby experienced a *reductio ad absurdum*. But it is within the scope of the present discussion to indicate that such divisions, if they have any effect at all, can only operate prejudicially to the freedom and completeness of the intellectual discussions of the congress. The essential trait of the scientific life of to-day is its democracy, its give-and-take, its live-and-let-live character. Scientific

men of to-day are struggling hard and successfully to break down previously existing artificial walls separating different sciences, and to secure a continuous open and free field of inquiry. The most active sciences of the day have bifold names—astro-physics, physical chemistry, geo-physics, physiological chemistry, psycho-physics, social psychology, to take the first names that suggest themselves. Pick up the first authority that comes to hand upon the science of language: we read that language has two sides, meaning and form; that the explanation of meaning is a matter of psychology and of logic, while the problems of form are treated by phonetics and phonology which are a combination of physics and physiology. Turn to the committee's classification and we find that the science of language is officially recognized as a science of 'purposes,' not 'phenomena,' and hence excludes psychology. It is a science of *individual* purposes, and hence excludes logic. As a science of purposes, not phenomena, it also excludes physics or physiology or any combination of them. The case is typical, and conclusive of the fated practical inefficiency of a plan which attempts to arrange sciences—*i. e.*, branches of inquiry—according to *a priori* logic. The 'chance combinations of the university catalogue' in the laying off of the fields of inquiry may not conform to any existing 'ground plan' of metaphysical logic; but they have at least the modest merit of representing the vital activities of those engaged in the cooperative pursuit of truth and the building up of the working system of human knowledge.

The dilemma that presents itself after reading the article is the following: Either the scheme is one for presentation and discussion in literary and philosophical journals, not intended to have any influence upon the practical conduct of the Congress, or else it represents a theory of the constitution and divisions of human knowledge to which the various sections and subsections are really expected to conform themselves. In the first case, it is impossible to see why, in the *Atlantic* article, so much stress is laid upon the philosophical basis and aim of the Congress, upon the fact that it is an arrangement based not upon considerations of practical convenience, but upon a logic of knowledge. In the second case, the effect upon the Congress itself can only be disastrous. The imagining of some one invited to speak who does not accept the scheme, either in general or in its bearings upon the particular group of sciences which he is called upon to discuss, will serve as a convenient symbol for presenting the practical logic of the situation. Is he to decline because he can not accept the preordained formulations of the committee? If so, is such a result regarded as desirable from any point of view? Or is he to accept and to proceed with a complete ignoring of the 'ground plan' set forth? If so, what is the significance of the 'ground plan,' and how does the scheme in any way differ from one which should have based itself purely upon an empirical grouping of current lines of research made upon the basis of convenience?

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CONCERNING THE WORD BAROMETER.

To the Editor of Science: In the issue of April 3, Dr. H. C. Bolton, quoting from Birch's edition of Boyle's Works, 1744, finds the word 'barometer' first used by Boyle in 1667, and he concludes that he probably used it as early as 1665.

In the issue of May 1, Mr. A. L. Rotch shows that Boyle did use the word as early as March 24, 1665.

I have before me the works of Robert Boyle, the title page of which tells us that the work was 'Printed for A. Millar, opposite Catharine Street in the Strand MDCCXLIV.' This edition is in five folio volumes and contains a preface by Thomas Birch dated London, November 16, 1743. It is not, however, the 'Birch' edition quoted by Dr. Bolton, as the page references do not coincide.

I find Dr. Bolton's quotations given on page 28 of Vol. III., and on p. 449 of Vol. II. The paper quoted by Mr. Rotch appears twice, first in Vol. V., p. 130, under the title as given by Mr. Rotch; second in Vol. II., p. 543, un-

der a slightly different heading and with the statement, 'First printed in the *Philosophical Transactions,* No. XIV., p. 256, for Monday, July 2, 1666.'

It is, however, when we turn to Robert Boyle's correspondence that the most interesting evidence on the subject is found.

1. In a letter by Robert Boyle to Mr. Henry Oldenburg, secretary of the Royal Society, dated March 19, 1665 (Vol. V., p. 250), he says: '* * * And to answer the former first, I wonder not there should be a mistake in the barometrical paper I sent you, the haste I was in having kept me from reading it over.' This letter doubtless refers to the paper presented to the Royal Society on March 24, 1665. This is, so far as I can find, the earliest use of the word by Boyle himself. It would seem from the context that it had been used before.

2. This conclusion is supported by letters to Robert Boyle. Thus (Vol. V., p. 471) Mr. John Beal, a fellow of the Royal Society, writes to R. B. on February 6, 1665, as follows: 'Persons of no ordinary capacities do find your three discourses of thermometers and baroscopes difficult.'

3. Mr. Henry Oldenburg writes on October 27, 1664 (Vol. V., p. 314): 'I did enquire at *Gresham* about the station of the barometer and was informed * * * .' This would seem to be in response to a request from Robert Boyle wherein he may have used the same term. (This letter of R. B.'s, if it exists, is not given.)

4. The person from whom Mr. Oldenburg in all likelihood made his 'enquiry' was Robert Hooke, who at this time was a resident of *Gresham* College and much interested in barometric work. In one of his letters to Robert Boyle I find the earliest use of the term under discussion. On October 6, 1664, he writes (Vol. V., p. 537): 'I have also, since my settling at *Gresham* College, which has been now full five weeks, constantly observed the baroscopical index (the contrivance, I suppose, you may remember, which shows the small variations of the air).' That the term is new to him is evidenced by his letter of September 15, 1664 (Vol. V., p. 536), in which he uses the term 'Torricellian' where 'barometrical' might have been used, also by his return to the older usage in his letter of December 13, 1664 (Vol. V., p. 542), wherein he says: 'I have lately observed many circumstances in the height of the mercurial cylinder * * * .'

To sum up: we find during the fall of 1664 a renewed interest and experimental activity in barometrical experiments. Associated in this work were *Robert Boyle, Henry Oldenburg, Robert Hooke* and others; thus *H. O.* writes to *R. B.* on September 1, 1664, as follows (Vol. V., p. 307): "On Monday last a club of our philosophers went to *Paul's* to make experiments of falling bodies, and of pendulums; there were Sir *R. Moray, Dr. Wilkins, Dr. Goddard, Mr. Palmer, Mr. Hill, Mr. Hook;* and some of them went to the top of the steeple and let down a pendulum of 200 foot long, with an appendant weight of — lb., and found two vibrations thereof made in 15″. Time would not then give leave to proceed to the other experiments that were designed; among which will also be the Torricellian; but they will be set upon within two or three days." Robert Hooke's letters show the same activity. In the letters of this period we find three persons, and perhaps four, using the term as follows: Robert Hooke, October 6, 1664; Henry Oldenburg, October 27, 1664; John Beal, February 6, 1665; Robert Boyle, March 19, 1665. All these gentlemen had the requisite linguistic knowledge to coin the new word.

I am much inclined to think that the letter of John Beal given as of date February 6, 1665, should read '1666.' I thus conclude, first from the order of the letter, preceded as it is by one of date November 9, 1665, and followed by one of date March 31, 1666, and second, from references in the letter to Boyle's papers on thermometers and baroscopes, which papers must have been those presented or published during 1665, as I find no earlier date given for any of them. It is to be regretted that no letters from Robert Boyle are given from October, 1664, to March, 1665. Indeed the discussion of the question is in-

complete without an examination of the memoirs of both H. Oldenburg and Robert Hooke.

I am inclined to think, all things considered, that a complete survey of Robert Boyle's papers, were that possible, would show him to be the author of the word. A parallel case of word-making by him is found in the following letter to Mr. Oldenburg dated September 8, 1665, in which he says: " * * * * that among some hydrostatical things I was once pursuing, I bethought myself of an easy slight instrument, which I called the measuring (or steriometrical) balance * * * * " (Vol. V., p. 250). At all events Robert Boyle made the first public use of the word in his papers of March 24, 1665. Strict historical priority, however, must be given to Robert Hooke. The anonymous passage in the *Philosophical Transactions,* quoted by Dr. Bolton, I should be inclined to credit to the secretary of the Royal Society, H. Oldenburg, rather than to Robert Boyle.

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SHORTER ARTICLES.

ON A NEW LILAC-COLORED TRANSPARENT SPODUMENE.

The mineral spodumene is generally known in large opaque whitish crystals, but occasionally it appears in small specimens that are transparent and richly colored. Such are the clear yellow gem-spodumene of Brazil,* the green variety hiddenite, or 'little emerald,' of North Carolina,† and the lilac or amethystine pieces rarely found at Branchville, Conn.‡ These last are plainly remnants of what must once have been elegant specimens; but spodumene is extremely subject to alteration, and has generally lost all its transparency and beauty of tint.

A notable discovery has just been made, however, of large splendid crystals of transparent unaltered spodumene, of rich lilac color, in connection with other lithia minerals, in San Diego Co., Calif. The locality is a mile and a half northeast of the town of Pala, and less than a mile from the famous rubellite and lepidolite mine at that place. Pala is already one of the most remarkable lithia localities known; amblygonite has been found there by the ton, and the lepidolite is estimated to occur by thousands of tons; while the pink rubellite crystals in the lilac lepidolite are familiar ornaments in every fine mineralogical cabinet.

At the new locality spodumene crystals occur up to the size of a man's hand, entirely clear, and of a rosy lilac tint, varying with the spodumene dichroism from a very pale tinge when looked at transversely to the prism to a rich amethystine hue longitudinally. If cut and mounted parallel to the base, these will undoubtedly yield gems of great beauty. No such crystals of spodumene have ever been seen before, and the discovery is one of extreme interest. A marked difference in color is noticeable also in these crystals, according as they come from some depth in the rock or lie nearer to the surface, the former having a deeper tint. This difference is doubtless due to the effect of air, water and light, which so frequently affect the color of minerals for some little distance into the rock. The material is exceedingly pure, with a hardness of about 7, and specific gravity (average of three crystals) of 3.183. The crystals are somewhat etched and corroded, and have a twinning, like the hiddenite variety, about the *a* (100) face; this is strikingly shown in the etched crystals, where the etching extends to the twinning-plane, and there stops.

Close to the opening, also, a splendid occurrence of colored tourmaline was found, some of the crystals being a foot long and three inches across, of rich pink rubellite with an exterior coating, or terminal caping, of dark blue indicolite.

Some similar, though smaller, crystals of transparent lilac spodumene were brought to the writer last winter, ostensibly from Hermosillo, Mexico; they were, however, found near Menchoir, California.

As this is an entirely new gem of a peculiar beauty, a name will be given to it as soon as its characteristics are definitely determined.

George Frederic Kunz.

* Pisani, *Comptes Rendus,* 84, 1509, 1877.
† J. L. Smith, *Am. J. Sci.,* 21, 128, 1881.
‡ Penfield, *id.,* 20, 259, 1880.

THE WATER SUPPLY OF HAVANA, CUBA.

UNTIL recent years the water supply of Havana came from the Almendares River. During the nineties the present water works, deriving the entire supply from large springs at Vento on the south bank of the Almendares Rivers, was completed. The Vento Springs and the covered aqueduct leading its waters under the Almendares River and into Havana are the pride of the city of Havana which has erected an imposing monument to the engineer by whom the work was conceived. The Vento Springs are surrounded by masonry walls sloping outward from the springs except on the side nearest the Almendares River, where they are vertical. The surface water running down the slopes of the masonry is caught in a gutter which discharges it into the Almendares. At the top of the masonry and some distance removed from its margin another gutter catches the surface water of the region sloping toward the springs and discharges this also into the Almendares. The water flows direct from the spring into the covered aqueduct. The provisions for maintaining the water in its original purity from the time it issues from the ground till it is discharged, either into the reservoirs near the city or direct from the faucets in the city, are ideal.

There has been some speculation as to the origin of the water issuing from the spring at Vento. The water is beautifully clear and rather warm, having a temperature of 26° C. at the time of our visit. The Almendares River, flowing but a few feet away, also has clear water except after heavy rains, and its water at the time of our visit was slightly colder than that of the springs. It is possible that the Vento Springs derive their water from the upper courses of the Almendares, though this is so highly improbable that the suggestion may be left out of consideration. The springs being situated on the south side of the lower course of the Almendares, the region across the river—that is the region north of the river—may be excluded as a possible contributing source of the supply of the Vento Springs. The region about the springs is composed of coralline rock. In such porous material conditions under which territory on one side of a river may contribute to springs located on the opposite side of a river are impossible.

The most probable origin of the Vento water supply can best be understood after a general statement of the conditions of the surrounding region.

The southern slope of the provinces Guanajai, Havana and Matanzas is largely drained by underground streams. The streams arising in the hills and mountains, forming the watershed between north and south drainage, run above ground for a distance and then disappear underground. The Ariguanabo River thus runs into a bank at San Antonio de los Baños and disappears among fallen rocks. A few yards away from its 'sumidero' the water can be seen running in its underground channel through an opening in the thin roof of the channel. A few yards further on a dry cave leads down to the water, which at the end of the dry cave disappears among fallen rocks. Other rivers disappear in a similar manner. They can not be followed in their underground courses because they completely fill them. The underground waters and the channels in which they run can, however, be reached in places through sink-holes. The streams reappear, in part, at least, in a number of 'ojos de agua,' some near the coast south of San Antonio. The region drained by underground streams is comparatively flat, with frequently no indications of surface streams and their erosion, and extends westward to near San Cristobal where the first permanent surface stream is observed. At Artemisa and Candelaria stream beds contained pools of water in March, 1902.

From San Cristobal to Pinar del Rio there are many small perennial streams. Eastward from San Cristobal the cave region has an unknown extent. Poey limited it to the jurisdiction of Guanajay, but it certainly extends as far east as the meridian of Matanzas and from reports probably beyond Cienfuegos. East of Rincon there are, however, frequent river beds, all but one of which were dry during the time of our visit. This main cave region belonging to the southern slope

sends a tongue northward from Rincon to the Vento on the Almendares River in the northern watershed. Aside from the 'Ojos de agua' along the edge of the cienegas skirting the southern coast there are two notable places where underground rivers find an exit; the one at Vento, as already mentioned, supplies the entire city of Havana with its water, the other serves to make the region about Guines a garden, its waters being used for irrigation. Other subterranean rivers in all probability have a subaqueous exit to the south.

The large spring at Vento is the only one on the northern slope as far as I know. The exact origin of the supply issuing from the Vento Spring has not been traced. But the region north of the Almendares River, being shut out from a possible contributing source, it undoubtedly derives its water from the tongue of the system of underground streams thrust into the northern slope. An examination of the best available map and the levels of the Western and United Havana Railroads makes it seem quite certain that the Vento Springs derive their water from the region immediately south of Vento and north of Rincon and Bejucal. This region contains various sinks without surface outlets, as well as dry sink-holes. A notable sink-hole in this region is that at Aquada on the United Havana Railroad. This is very broad, shallow and dry during the dry season but the water rises to stand over ten feet deep on the railroad track during some of the wet seasons. All of these probably drain into the Vento Springs.

It behooves the health authorities of the city of Havana to exercise the strictest guard over the region between Vento on the north and Rincon and Bejucal on the south. Any contamination of sink-holes in these regions is sure, during the wet season at least, to contaminate the underground streams leading to Vento. An examination of the underground channels in the Lost River region of Indiana has shown the main underground channels to be provided with numerous smaller tributary channels which in ordinary weather do not carry water, but which do carry water into the main stream after a long rain. At such a time any filth that may have accumulated in any of the sink-holes over one of the tributary streams is sure to find its way into the main stream. The same is very probably true of the Vento supply, although on account of the nature of the region it is not possible to follow the underground channels. At present some of the sink-holes between Rincon and Vento are used as cess-pools and receivers of sewage.

C. H. Eigenmann.

NOTES ON PHYSICS.

GROUP AND WAVE VELOCITY.

The question was raised at the Pittsburg meeting of the American Association, in a private discussion of Professor Brace's scholarly vice-presidential address, as to the physical distinction between wave and group velocity of light. Undoubtedly the best physical discussion of this matter is to be found in the remarkable chapter on plane electromagnetic waves in Chapter IV., Vol. I., of Heaviside's 'Electromagnetic Theory,' especially in his discussion of the generation of tails. A simple conception of the distinction between wave and group velocity is as follows: Imagine a stretched rubber tube with a series of equidistant weights suspended from the tube by helical springs and imagine a train of say one hundred equidistant similar waves to be started along this tube. The head of this wave train, as it runs out at full speed (wave speed) upon the previously stationary portion of the stretched tube, exerts upon each element of the tube a series of periodic forces, and because of the suspended weights these periodic forces require some perceptible time, ten or fifteen cycles, say, to establish the full oscillatory motion corresponding to the full amplitude of the wave train. Therefore, although the head of the wave train runs out on the tube at full speed, there is a gradual rise in amplitude from the extreme head backwards towards the middle of the train. Furthermore, as the main portion of the wave train leaves a portion of the tube this portion of the tube persists for an appreciable time in oscillations of diminish-

ing amplitude because of the suspended weights, so that the advancing wave train leaves behind it an ever-lengthening tail, of which the amplitude diminishes backwards. The extreme head of the wave train travels at what is called the *wave velocity* and the middle of the spreading train travels at what is called the *group velocity*. Strictly, the term *wave velocity* applies to the ratio wave-length divided by periodic time in the middle region of a train of waves so long that the diminishing amplitudes in head and tail are without influence.

It is a curious fact, as has been pointed out by Heaviside, that a periodic wave train in a dispersing medium is about the only kind of wave that can be put into simple mathematics, while a mere wave pulse is the only kind that is simple physically. Physically a wave train in a dispersing medium is a very complicated phenomenon.

VARIATION OF WEIGHT WITH CHEMICAL AND PHYSICAL CHANGES.

The electromagnetic theory of inertia, in which the inertia of matter is attributed to corpuscular electric charges in the structure of atoms, leads one to expect a decrease in the total inertia of two substances like H and O when they combine to form water for the following reasons. A moving electric charge has inertia. The amount of this inertia is determined by the extent to which the electric lines of force from the charge permeate surrounding space, for this determines the extent of the magnetic field which is produced by the movement of the charge. Most of the inertia effect is, however, in the region near the charge, for there the electric field and also its magnetic effect are greatest. Two adjacent opposite charges side by side have less electrical inertia than the same two charges widely separated, for the reason that the electric lines of force permeate less into remote regions of space.

If inertia and gravitation vary together we should thus expect a given amount of O and H to weigh less when these substances are combined to form water.

Very careful attempts have been made to detect changes in weight due to chemical changes by Landolt in 1893 and by Heydweiller in 1900, and the changes are so small as to be questionable. Attention was called in 'Physics Notes' several years ago in SCIENCE to the fact that a variation of weight (or mass) with chemical changes would by no means necessarily vitiate the principle of the conservation of matter, so that such changes, if they exist, are of most importance in their bearing upon the perplexing questions of gravity and inertia.

Recently it is announced that Professor Babcock has established the fact of the variation of weight with chemical and physical changes. He is reported to have used a special form of hydrostatic balance capable of detecting a change in weight of one part in a hundred million. This degree of refinement is in fact about that which can be reached by the ordinary balance, and when we remember that the temperature of his water-bath would, unless compensating devices are devised and used, have to be controlled to about 1/40,000 of a centigrade degree to enable him to avail himself unmistakably of a sensitiveness of one part in a hundred million, it seems doubtful that he could have realized a sensitiveness anything like as great as that at the disposal of Landolt in 1893, at the disposal of Heydweiller in 1900 and also at any one's disposal now in 1903. When the buoyant force of the air, only, is involved temperature must be controlled to about 1/400 of a centigrade degree to enable one to detect unmistakably so small a variation in weight as one part in a hundred million. W. S. F.

RESOLUTIONS OF THE NATIONAL EDUCATIONAL ASSOCIATION.

THE committee on resolutions at the Boston meeting of the National Educational Association, which consisted of Nicholas Murray Butler, of New York, Chairman; Andrew S. Draper, of Illinois; James M. Green, of New Jersey; Bettie A. Dutton, of Ohio; H. B. Frissell, of Virginia; prepared the following declaration, which was adopted by the association.

1. The United States Bureau of Education has amply proved its usefulness to the nation. Its publications are standard works of reference for school officers and teachers everywhere. The Bureau of Education should be made an independent administrative department, such as were the Departments of Agriculture and of Labor before their elevation to Cabinet rank. Sufficient appropriations should be made by the Congress to enable the Commissioner of Education to extend the scope and add to the usefulness of his work.

2. The condition of affairs in the Indian Territory, where fully three quarters of the population are reported as being without schools for their children, demands the immediate attention of the Congress. Provision should be speedily made by which the people of the Indian Territory will have power to establish and carry on a system of public schools so that all classes of citizens in the Indian Territory may have the educational opportunities which are enjoyed by their fellow-citizens in other parts of the country.

3. Teaching in the public schools will not be a suitably attractive and permanent career, nor will it command as much of the ability of the country as it should, until the teachers are properly compensated and are assured of an undisturbed tenure during efficiency and good behavior. A large part of the teacher's reward must always be the pleasure in the character and quality of the work done; but the money compensation of the teacher should be sufficient to maintain an appropriate standard of living. Legislative measures to give support to these principles deserve the approval of the press and the people.

4. The true source of the strength of any system of public education lies in the regard of the people whom it immediately serves, and in their willingness to make sacrifices for it. For this reason a large share of the cost of maintaining public schools should be borne by a local tax levied by the county or by the town in which the schools are. State aid is to be regarded as supplementary to, and not as a substitute for, local taxation for school purposes. In many parts of the United States a large increase in the amount of the local tax now voted for school purposes, or the levying of such a tax where none now exists, is a pressing need if there are to be better schools and better teachers.

5. The highest ethical standards of conduct and of speech should be insisted upon among teachers. It is not becoming that commercialism or self-seeking should shape their actions, or that intemperance should mark their utterances. A code of professional conduct clearly understood and rigorously enforced by public opinion is being slowly developed, and will, doubtless, one day control all teachers worthy of the name.

6. It is important that school buildings and school grounds should be planned and decorated so as to serve as effective agencies for educating not only the children but the people as a whole in matters of taste. The school is becoming more and more a community center, and its larger opportunities impose new obligations. School buildings should be attractive as well as healthful, and the adjoining grounds should be laid out and planned with appropriateness and beauty.

7. Disregard for law and for its established modes of precedure is as serious a danger as can menace a democracy. The restraint of passion by respect for law is a distinguishing mark of civilized beings. To throw off that restraint, whether by appeals to brutal instincts or by specious pleas for a law of nature which is superior to the laws of man, is to revert to barbarism. It is the duty of the schools so to lay the foundations of character in the young that they will grow up with a reverence for the majesty of the law. Any system of school discipline which disregards this obligation is harmful to the child and dangerous to the state. A democracy which would endure must be as law-abiding as it is liberty-loving.

THE AMERICAN ELECTROCHEMICAL SOCIETY.

The fourth general meeting of the American Electrochemical Society will be held at Niagara Falls, N. Y., September 17, 18 and 19, 1903. Thursday and Friday afternoons will be devoted to visits to power houses and

certain of the electrochemical plants which are open to visitors, and to other points of interest in the vicinity.

Thursday evening there will be a smoker and entertainment. Friday evening a dance and reception at the Cataract House. Saturday evening will be devoted to a trip to Niagara-on-the-Lake, Youngstown and Port Niagara by boat and trolley.

The following titles of papers have been announced:

P. G. SALOM: 'A New Type of Electrolytic Cell.'

DR. GEORGE P. SCHOLL: 'Manufacture of Ferro-Alloys in the Electric Furnace.'

DR. W. D. BANCROFT: 'Electrolytic Copper Refining.'

DR. W. H. WALKER: 'Electrometallurgy of Gold.'

F. A. J. FITZGERALD: 'Some Theoretical Considerations of Resistance Furnaces.'

F. AUSTIN LIDBURY: 'On the Supposed Electrolysis of Water Vapor.'

PROFESSOR O. W. BROWN: 'Efficiency of the Nickel Plating Tank.'

CARL HAMBUECHEN: 'Electrolysis of Sodium Hydroxide, by Alternating Current.'

PROFESSOR C. F. BURGESS: 'A Practical Utilization of the Passive State of Iron.'

DR. E. F. ROEBER: 'The Present Status of the Theory of Electrolytic Dissociation.'

C. J. REED: 'Berthelot's Law of Electrochemical Action.'

Other papers are expected from Dr. J. W. Richards, David H. Browne, Dr. L. Kahlenberg, Professor C. F. Burgess, A. H. Cowles and others. One session of the meeting will be devoted to the discussion of the theory of electrolytic dissociation, which will be opened by Dr. W. D. Bancroft.

It is announced that "negotiations have now been practically completed for supplying to all members free the Transactions of the London Faraday Society (the recently formed British Electrochemical Society), which are published in the *Electrochemist and Metallurgist* issued monthly. This is to be accomplished by supplying our Transactions free to the members of the Faraday Society. There will be no increase in our annual dues on account of this free exchange, and the benefit to be derived by our members is obvious. It is also evident that this new arrangement entails considerable additional expense upon our society. The continuance of this agreement will require not only the greatest economy in the administration of our funds, but also the active support of our individual members in maintaining and increasing our membership."

SCIENTIFIC NOTES AND NEWS.

THE following honorary doctorates have been conferred by the University of Heidelberg, on the occasion of the centenary of its reopening: Mathematics, M. G. Darboux, Paris; physics, Dr. R. T. Glazebrook, London; astrophysics, Sir William Huggins, London; chemistry, Professor S. Cannizzaro, Rome; mineralogy, Professor F. Fouqué, Paris; astronomy, Professor E. C. Pickering, Harvard University; zoology, Professor E. Maupas, Algiers; botany, A. Cogniaux, Nivelles.

DR. F. R. HELMERT, director of the Geodetic Institute at Potsdam, has been elected a foreign member of the Turin Academy of Sciences.

A *Festschrift* is in course of preparation to be presented to Professor J. P. Pawlow on the twenty-fifth anniversary of the beginning of his scientific work, which occurs next year. It is proposed at the same time to endow in his honor a prize for research in physiology.

A BRONZE medal is to be struck in honor of Professor Cornil, of Paris, to commemorate his work on the history of pathology and bacteriology.

PROFESSOR O. ISRAEL has been appointed curator of the Pathological Institute of the Berlin Charity Hospital.

DR. KARL SCHÖNBERG has resigned the chair of surgery at the University of Würzburg, owing to a stroke of paralysis.

DR. STUHLMAN has been appointed director of the Biological and Agricultural Institute at Amani in German East Africa.

DR. ROSANES, professor of mathematics and physics, has been elected rector of the University of Breslau.

Dr. Kolthoff with a party of Swedish naturalists will begin this year an exploration of the northern parts of the Pacific Ocean, starting from Port Arthur.

Dr. D. T. MacDougall, director of the laboratories of the New York Botanical Garden, has returned from a trip to Jamaica in the interest of the garden. Dr. M. A. Howe, assistant curator, has been in Porto Rico, and Mr. George V. Nash has been in Hayti, on a similar mission.

According to *Nature* the following American and other foreign corresponding members of the British Association have signified their intention of being present at the Southport meeting: Professor G. S. Atkinson, Cornell University; Dr. Von Bebber, Hamburg; Dr. R. Billwiller, Zurich; Professor Ludwig Boltzmann, Vienna; M. Teisserenc de Bort, Paris; Captain Chaves, St. Miguel, Azores; Mr. W. Davis, Cordoba, Argentine; Professor G. Gilron, Louvain; M. A. Gobert, Brussels; the Comte A. de Gramont, Paris; Professor Hellman, Berlin; Professor H. Hergesell, Strassburg; Professor H. H. Hildebrandsson, Upsala; Professor Lignier, Caen; Professor C. Lombroso, Turin; Dr. T. P. Lotzy, Leyden; Mr. G. G. MacCurdy, New Haven, Conn.; Professor E. Mascart, Paris; Professor H. Mohn, Christiania; Professor Willis Moore, Washington, D. C.; Professor Simon Newcomb, Washington, D. C.; Professor L. Palazzo, Rome; Professor Paulsen, Copenhagen; Professor J. M. Pernter, Vienna; Dr. A. L. Rotch, Blue Hill Observatory, Mass.; General Rykatcheff, St. Petersburg; Professor M. Snellen, Utrecht; Professor R. H. Thurston, Cornell University; Dr. H. C. White, University of Georgia; Professor E. Zacharias, Hamburg.

We regret to note the following deaths among foreign men of science: Dr. Emmanuel Munk, associate professor of physiology at Berlin, on August 1, at the age of fifty-one years; Dr. C. K. Hoffman, professor of zoology and comparative anatomy at Harlem, on July 28, at the age of sixty-two years; Dr. N. Bugajew, professor of mathematics at Moscow, at the age of sixty-six years; Dr. Franz Schwackhöfer, professor of chemical technology in the school of agriculture in Vienna, on July 18, at the age of sixty-one years; Dr. Sigmund Fuchs, professor of physiology in the same school, on July 30; Professor Karl Hausknecht, of Weimar, the botanist, on July 7.

Official statistics have been published giving the enrollment of members at the Boston meeting of the National Educational Association, which reached the remarkable total of 32,757. The distribution of members in attendance is of considerable interest, as many as 3,748, for example, going from Illinois, and the total number from the north central states reaching 14,545. Scientific men of the Atlantic seaboard object to a meeting of the American Association for the Advancement of Science or of our other national scientific societies in the central states, and members from the central states do not attend meetings held in the east in very large numbers. It seems that we have much to learn from the spirit and organization of the National Educational Association.

The government of New Zealand will assist the Australasian Association for the Advancement of Science, which meets at Dunedin next January, in several ways. A sum of £500 will be appropriated towards the expenses of the meeting; the government printer will do all printing required by the association free of cost; railway passes will be issued to members; and any assistance that it may be in the power of the permanent departments of the government service to render to the association will be afforded.

The International Geological Congress opened its sessions at Vienna on August 20. A large number of American geologists went abroad this summer with the intention of attending the congress.

Pursuant to the action of the Seventh International Geographic Congress held in Berlin in 1899, the geographers and geographic societies of the United States are considering plans for the ensuing congress, which is to convene in September, 1904. It is proposed to have the principal scientific sessions in

Washington early in the month, and to have social sessions in New York, Philadelphia, Baltimore and Chicago, with a final session in conjunction with the World's Congress of Science and Arts in St. Louis. It is provisionally planned also to provide an excursion from St. Louis to Mexico, and thence to points of geographic interest in western United States and Canada. A preliminary announcement is in press and will shortly be issued to officers and members of geographic societies in all countries, and to geographers who may express interest in the congress and its work. Details have been entrusted to a committee of arrangements made up of representatives from geographic societies in all parts of the United States. The officers of the committee are: Dr. W J McGee (vice-president National Geographic Society), chairman; Mr. John Joy Edson (president of the Washington Loan and Trust Company), treasurer; and Dr. J. H. McCormick, secretary. The office of the committee is in Hubbard Memorial Hall, Washington, D. C., where communications may be addressed.

THE sixth annual session of the American Mining Congress will meet at Deadwood and Lead, South Dakota, beginning on September 7.

THE fourteenth annual meeting of the British Institution of Mining Engineers will be held in the University College, Nottingham, beginning on September 2.

THE ship *Terra Nova* has now sailed from Dundee to relieve the *Discovery*. The British government, which has appropriated £45,000 for the expedition, is apparently acting without the advice of the Royal Geographical Society and the Royal Society, which originally sent the expedition, assisted by a grant from the government. Mr. Balfour in the House of Commons criticized the societies for not foreseeing the difficulties into which the *Discovery* has fallen, but afterwards withdrew his criticism as far as the Royal Society is concerned. At almost the same time the *Fritchjof* sailed from Sweden for the relief of the expedition under Professor Nordenskjold. The Swedish parliament has appropriated $50,000 for this purpose.

THERE will be a civil service examination on September 23 and 24 for the position of draftsman in the U. S. Geological Survey, with a salary of $1,400 a year. The examination will consist chiefly of practical work, retouching photographs for photoengraving and pen-drawing from photographs.

P. BUDIN in his report to the Commission de Depopulation on infant mortality gives statistics, which are summarized in the *British Medical Journal*. In Paris 145 out of every 1,000 deaths are of children under a year old, and in St. Pol-sur-Mer the proportion is as high as 509 per 1,000. During the years 1896–1900 the average annual mortality of children under one year in France was 134,434; in fact the proportion of death to survivors of the same age was higher for the first year than for any other year below the 91st. The report first discusses the direct medical causes of this mortality. The three most important are infantile diarrhoea, respiratory diseases, and congenital debility. Of these, infantile diarrhœa accounts for far the greatest number of deaths. Out of every 1,000 infants dying in Paris 380 die from diarrhœa, in Rouen 510, in Dijon 584, in Troyes 682. The system of feeding is the most important factor in this result. Of 69 children dying of diarrhoea at Boulogne, 8 only were breast-fed children, 20 were bottle-fed, and to 41 solid food had been prematurely given. The diarrhoea of breast-fed children is caused by excessive and irregular feeding. Bottle-fed children are often enormously overfed, a fault which acts most injuriously in hot weather, when least food is needed. The milk given is often of bad quality, containing bacteria, adulterated, or wanting in cream. The chief cause of death amongst congenitally weak children, especially if they are undersized, is exposure to cold. The feeding of these children requires skill. If too little food is given they become cyanosed and die, if too much they succumb readily to diarrhœa. Coming next to non-medical conditions tending to increase infant

mortality, Budin states that the death-rate is abnormally high among illegitimate children and those whose lives have been insured, and also among children of working women who are obliged to entrust them to the care of others, whether paid or unpaid. On the other hand, the mother who feeds her own child at the breast may almost always expect to rear it, in the absence of special risks, such as an alcoholic tendency on the part of the mother, which of course affects the milk. The reduction of an excessive infant mortality is a question of obvious importance in a country which, like France, has a stationary or declining population; and in suggesting remedies, most of which follow directly from the causes to which the excessive mortality is assigned, Budin demands state intervention as well as more intelligent individual effort. Every mother who can do so should be induced to suckle her own child. The importance is urged of mothers bringing the children each week to a doctor to be weighed and inspected. These consultations are of the utmost benefit wherever doctors feel it their first duty to secure that all mothers shall, if possible, suckle their children. Where the mother's milk is insufficient, some sterilized milk may be supplied, but complete artificial feeding should be deferred as long as possible. Budin himself sees about 100 children weekly in this way, and during four years not one under his care has died from diarrhœa. Other suggestions are: (1) That women be not allowed to go to work for a month after delivery, compensation to be given during this time; (2) that a nursing mother be allowed to leave work twice a day to feed her child; (3) that municipalities ensure the good quality of milk sold; (4) that the manufacture and sale of long-tubed bottles be made illegal; (5) the inspection of all children not under the care of their parents; (6) the treatment in hospital of prematurely born children below a certain weight; (7) the prohibition of the insurance of infants.

UNIVERSITY AND EDUCATIONAL NEWS.

The Lord Mayor of Liverpool has proposed that a tax be levied to cover the expenses of the University of Liverpool, and that tuition should be made free in all departments. Should this plan be carried into effect, Liverpool would be the only university in Great Britain without tuition fees.

The *Journal of the American Medical Association* states that all the medical schools in the country now have a four years' course, this having been adopted by three schools in 1902 and this year by the last school with a three years' course.

It is said that plans have been perfected for combining the faculties of medicine of Toronto and Trinity Universities.

The following were recently appointed as assistants in the department of histology and embryology at Cornell University: Wm. A. Hilton, Ph.D. (Cornell); S. G. Winter, A.M. (Ohio), and Geo. W. Partridge, A.B. (Rochester).

Charles H. Shaw has been appointed adjunct professor of botany in the department of pharmacy of the Medico-Chirurgical College, Philadelphia.

Dr. Ernst Steinitz has been elected professor in the Technical Institute at Charlottenburg, in the room of the late Professor Hamburger.

The Royal Commissioners for the exhibition of 1851 have made appointments to science research scholarships for the year 1903, on the recommendation of the authorities of the several universities and colleges. The scholarships are of the value of £150 a year, and are ordinarily tenable for two years (subject to a satisfactory report at the end of the first year) in any university at home or abroad. The scholars are to devote themselves exclusively to study and research in some branch of science the extension of which is important to the industries of the country. Fifteen new scholars are appointed, fifteen scholars are reappointed for a second year and six for a third year. Two of the students who are reappointed will study in the United States—Mr. G. B. Waterhouse at Columbia University and Mr. T. C. Hebb at the University of Chicago.